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ABSTRACT

A study was conducted: (1) to compare the popularity of computer stations with nine other activity stations; (2) to determine the differences in the type of play displayed by the children in preschool and note the type of play displayed at the computer stations versus the other activity stations; (3) to determine whether the preschool activities, particularly the computer activities, were teacher directed; (4) to describe the communication interactions; and (5) to determine whether children's choices of computer activities varied by sex. For 2 weeks, four observers gathered data in a classroom for 4-year-olds and a classroom for 5-year-olds. Both classrooms had housekeeping, art, language arts, blocks, cooking, science, and manipulative activities. The classroom for 4-year-olds had an Apple IIe computer, while the classroom for 5-year-olds had a PLATO terminal, a Turtle robot, and an Apple IIe computer. The children were free to choose among a number of software programs. Several measures were taken: (1) frequency counts of the number of children at each station; (2) identification of play behavior (using Parton's Play Classifications); (3) instances of teacher-directed play; (4) verbal interaction (using Flanders' Interaction Analysis Scale); and (5) frequency counts of the number of male and female children at computer stations. Results indicated that, while 4-year-old males used the computer extensively, other children seemed to engage in a wide variety of activities, including computer use. While activities generally were not teacher-directed, teachers did tend to direct the computer activities of the 4-year-olds and to use more praise in those activities. (These effects might have been due to the computer's relative novelty in that classroom.) The computers seemed to encourage both cooperative and independent play. (CB)

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A Study of the Behavior of Children in a Preschool Equipped with Computers

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In 1983 TIME magazine named a "Machine of the Year" instead of a "Man of the Year" because no one person "symbolized the past year more richly, or will be viewed by history as more significant, than a machine: the computer" (Meyers, 1983, p. 4). An indication of the pervasiveness of the computer revolution can be seen in the fact that the computer has been introduced into a rather unlikely area---the preschool (Burg, 1984; Hines, 1983; Swigger and Campbell, 1981). Bowen (1984) has reported that about 25% of the licensed preschools in the country to date have computers in their classrooms and she predicts that within five years 100% of those classrooms will contain microcomputers. Papert (1980) in his thought provoking book, Mind Storms, Children, Computers, and Powerful Ideas, has suggested that computers can provide children with pathways into knowledge for building ideas we had not thought possible. Ross and Campbell (1983) believe that computers are well suited to a Montessori classroom and Sheingold (1983) has suggested that microcomputers might be used by young children to develop skills ranging from discriminating between up and down and left and right to overcoming barriers to written expression. Computers are now being used in preschools to develop visual discrimination and readiness concepts (Legenhausen, 1983; Piestrup, 1981; Smithy-Willis, Riley, & Smith, 1982). to

teach reading (Mander, 1982), writing (Ausbell, 1983), and graphics (Piestrup, 1982).

Support for the introduction of computers into preschool classrooms is not universal. Cuffaro (1984) questions the appropriateness and timeliness of introducing 3, 4, and 5-year-old children to computers. She points out that computer activities involve collateral learnings that go beyond the specified aims of the activities. She argues that "It is when children move more firmly into functioning at the concrete operational level, at about age eight, that they are better able to take true advantage of all the challenges that computers and programming may offer" (p. 565). Abt (1980) fears that the TV-computer age has the potential to create social isolation and withdrawal leading to increased psychosis. Heller and Martin (1982) are concerned that children may choose to interact with machines instead of people. And, Barnes and Hill (1983) contend that children are likely to incur deficits in social behaviors if computers limit their social interaction.

While the concerns expressed about cognitive and social problems which may result from introducing computers to young children seem to be well founded, several reports suggest that computers foster prosocial behaviors in preschool classrooms (Hawkins, Sheingold, Gearhart & Berger, 1982) or they do not effect the established patterns of

social behavior (Wright & Church, 1895). Also, Jewson and Pea (1982) and White (1983) have found that preschoolers displayed more collaboration, turn taking, and other prosocial behaviors when they worked with microcomputers than when they engaged in other preschool activities. The results of these studies are interesting but far from definitive. They suggest a need to further investigate the behaviors of young children in preschools equipped with computers.

Purposes and Procedures

This study was conducted in a university preschool equipped with various activity stations including computer stations. The specific purposes of the study were: (1) to determine the popularity of the computer stations in comparison with the other activity stations; (2) to determine whether there were significant differences in the type of play displayed by the children in the preschool and to note the type of play that the children displayed at the computer stations in relation to the play that they displayed at the other stations; (3) to determine whether or not the preschool activities in general and the computer activities in particular were teacher directed; (4) to

describe the communication interactions which occurred in the preschool in general and at the computer stations in particular; and (5) to determine whether children's choices of computer activities varied according to sex.

In order to accomplish these purposes four trained, female observers systematically gathered data in two preschool classrooms for four weeks. Two of the observers were assigned the tasks of proceeding from station to station and recording the name of the station, the number and sex of the children at the station, the type of play observed at the station and whether or not the activity at the station was teacher directed. These observers alternated assignments between the classrooms of the 4 and 5-year-old children. The observers collected data during the one hour free play periods. They collected data at all stations at the beginning, during the middle, and at the end of each period and it took them about one minute to collect data at each station. The other two observers were assigned the tasks of categorizing verbal interaction at each activity station. These observers alternated assignments between the classrooms of the 4-year-old and five-year-old children. They collected data at each of nine stations during the one hour free play periods. They proceeded from station to station and recorded data for five minutes at each station. Each of the four observers systematically

varied the starting point of their observations to avoid introducing order of observation bias into the study.

Activity Stations

There were nine activity stations in each of the two classrooms involved in this study. The stations available to the 4-year-olds were: housekeeping; an Apple IIe computer; manipulative materials; an art, sensory, cooking, science area; a water and sand table; free art; an Atari 800 computer; cognitive and language arts; and blocks. The stations available to the 5-year-old children were: free art; language arts; housekeeping; blocks; a PLATO terminal; manipulative materials; a Turtle robot (Tasman Corp.); an Apple IIe computer; and an art, cooking, and science area. The computer stations were equipped with color monitors (except for the PLATO terminal which had a green screen), and the software available to children was interactive, educationally sound, and age appropriate. The children were free to choose among the following software programs: Magic Crayon (C & C Software), Facemaker (Spinnaker), Paint (Wreston Publishing Co.), The Sticky Bear ABC (Weekly Reader Family Software), Juggles Rainbow (The Learning Corp.), Sammy Sea Serpent (Program Design, Inc.), Counting Bee (Edu-ware Services, Inc.), Magic Melody Box (Atari

Program Exchange), and Delta Draw (Spinnaker). The Turtle robot operated with an accompanying disk from Flexible Systems Software.

Subjects

Thirty-two children served as subjects in this study. In the 4-year-old group were 9 males and 7 females and in the 5-year-old group there were 7 males and 9 females. These children were from middle or upper middle class families. In accordance with preschool policy, no more than one-half of these children were children of university faculty. All of these children had attended the university preschool during the previous fall semester. During that previous semester the 5-year-olds worked with the PLATO terminal and the Apple IIe computer throughout the semester and one-half of the 4-year-olds had four 20 minute sessions with the Apple IIe computer.

Data Gathered

Several types of data were gathered in this study. First, to determine the popularity of computer stations in comparison with the other stations, frequency counts were made of the number of children observed at each station.

Since these observations were made systematically when the children were free to choose the activity station they preferred, it was assumed that frequency counts would provide an accurate indication of the popularity of each station.

Second, to identify the type of play behavior which the children displayed, Parten's Play Classifications (1933) were used as the observations were made (see TABLE A for a presentation of the categories). Parten's classification system was selected because of its ease of use and its wide acceptance. The two observers had little difficulty in identifying and classifying the type of play behavior displayed by the children.

Third, the observers judged whether or not the activity of the children at the various stations was teacher directed or not teacher directed. An activity was coded as teacher directed when the teacher was involved with the activity and guiding it. An activity was coded as not being teacher directed when the teacher's presence was incidental to the activity or when no teacher was present.

Fourth, to describe the verbal interaction which occurred at each activity station Flanders' Interaction Analysis Scale (1970) was used (see TABLE B for a presentation of this scale). Every three seconds for four continuous minutes the observers coded the communication

behavior which they observed at an activity station. These codings were made on IBM scan sheets to simplify data analysis.

Fifth, to determine whether children's choices of computer activities varied according to sex, frequency counts were made of the number of male and female children present at a computer station when an observation was made.

Training Sessions and Reliability Checks

Prior to the start of this study the observers were trained to use the observational instruments they employed to gather data. This training involved a discussion of the instruments to be used, the procedures to be followed, and it included several sessions during which the observers practiced gathering data by observing the children in the university preschool.

Reliability checks were made during the practice sessions and periodically during the study by having the observers simultaneously code behavior at the same activity station. Agreement between the observers for the various codings was very high: 97% for play classification; 98% for teacher direction; and 95% for verbal interaction. The high level of agreement which occurred in this study can be

attributed to the uncomplicated nature of the instruments used, the discreteness of the judgments required, the effectiveness of the training sessions, and the fact that only four observers (2 teams of 2 each) were used.

Data Analysis

The data gathered in this study were discrete rather than continuous and thus nonparametric methods were used in the analysis. Statistical tests based on rankings of the data were used when they were deemed to be feasible and appropriate. When statistical tests were not possible percentages were calculated and reported.

Also, the data collected at the two computer stations in the classroom of the 4-year-olds was combined for analysis as was the data which was gathered at the three computer stations in the classroom of the 5-year-olds. This combining of data seemed appropriate because no more than three children and usually one or two children worked at a computer station at one time while four or more children were involved in the activities at each of the other stations.

Results and Discussion

Popularity of Computer Activities

In this study it was hypothesized that the computer activities would be more popular than the other activities found in the classrooms of the 4 and 5-year-old children. In order to test this hypothesis the frequency of participation in each activity was ranked for each child. Next, Friedman's Rank Sums (Hollander and Wolfe, 1973) were used to compare the children's use of the computers with their participation in each of the other activities.

To perform the Friedman test the difference between the total rank for use of computers and the total rank for a given activity was calculated. Using an experimentalwise error rate of .05, the null hypothesis that computers and a given activity were chosen equally was rejected when the absolute value of their total rank difference was larger than the tabled critical value, which for brevity was called K. For further discussion on computing this value see Hollander & Wolfe (1973).

TABLES C and D contain the data which pertains to the analyses made to determine the popularity of the computer activities. As can be seen in TABLE C, the 4-year-old males used the computers significantly more often than they used

manipulative materials; art, cooking, science; water and sand; free art; and cognitive language arts. Also, the 5-year-old females used the computers significantly more often than they used blocks (see TABLE D). No other statistically significant differences were found when the use of computers was compared with the other activities except for the difference which indicated that the 4-year-old females participated in housekeeping activities significantly more often than they used the computers (see TABLE C).

These results suggest that the 4-year-old males were captivated by the computer. The other children used the computer but not to the extent of the 4-year-old males. It is tempting to speculate about why the 4-year-old males were so involved with the computer and why the other children seemed to place the use of the machines in perspective. However, such speculations must be resisted until further research is conducted.

Children's Play Behavior

Parten's scale was used to classify children's play behavior. A summary of the results of the classifications pertaining to the play behavior of the 4 and 5-year-old children is presented in TABLES E and F. To determine

whether one or more of the types of play identified in TABLES E and F were exhibited significantly more often than another type of play behavior, the children in each age, sex group were ranked according to the frequency with which they displayed a particular type of play and multiple comparisons based on the ranks of the data were performed using Friedman's Rank Sums (Hollander & Wolfe, 1973). TABLE G presents these comparisons and their results. As can be seen in TABLE G, the 4 and 5-year-old males and 5-year-old females used parallel, associative, and cooperative play significantly more often than they used unoccupied or onlooker behavior. Four-year-old females exhibited parallel and associative play significantly more often than they displayed unoccupied and onlooker play (see Table G). Also, the 5-year-old females engaged in parallel play significantly more often than solitary play. No other statistically significant differences were detected.

The statistically significant differences which were found in children's play behavior can be attributed to the children's very limited use of unoccupied and onlooker play. Unoccupied play was observed only two times and onlooker play was observed only eight times. All of the other types of play were observed much more frequently.

In TABLE H data pertaining to the play behavior which the 4 and the 5-year-old children displayed at all stations

is presented and compared with behavior which they displayed at the computers. As can be seen in TABLE H, 37.8% of all the cooperative play and 21.2% of all the solitary play displayed by 4-year-olds occurred at the computer. Also, 40.3% of all the solitary play, 15.9% of all the associative play, and 15.6% of all the cooperative play occurred at the computer. These findings suggest that computer activities encourage both cooperative and independent play and thereby contribute to the goals of preschool education.

Teacher Direction

As the observers coded children's play behavior they noted whether or not the children's play at a station was teacher directed. The total N for these notations was 492 (TABLES I and J). Ninety-five of the 492 notations or 19.3%, were placed in the teacher direction category. Thus, the play behavior in the preschool was generally not teacher directed. Interestingly, 38 of the 95 teacher directed notations were made when the observers were coding children's play behavior at the computers.

In order to determine the statistical significance of the amount of teacher direction which occurred at the computer stations the children in each age group were ranked according to the frequency with which their computer

activities were teacher directed. Then, pairwise comparisons were made of the ranked data. The Wilcoxon Signed Rank Test (Hollander & Wolfe, 1973) was used to make these comparisons. Three 4-year-old children were deleted from the analysis because two of these children never used the computer and one child used the computer only once. All of the 5-year-old children used the computer and were included in the analysis. A statistically significant difference was found for the 4-year-olds but not for the 5-year-olds (TABLE K) indicating that while the computer activities of the 4-year-old children were teacher directed the computer activities of the 5-year olds were not. This finding probably occurred because the 4-year-old children had very little prior experience with using computers and thus they required teacher assistance to properly load and run the computer programs. The 5-year-old children had numerous opportunities to work with computers during the previous semester and thus they needed little or no help in running the machines. In addition, the observers reported that when the five-year-old children needed assistance they were likely to seek help from one of their knowledgable peers instead of a teacher. It is not clear why two of the 4-year-old children never used the computer and one child used it only once. It may be that these children were not developmentally ready for such experiences or that they had

no interest in the computer. Future research may help to determine whether many children choose not to use computers and why they choose not to use them.

Communication Interactions

The data collected to assess the communication interactions which occurred in preschool classrooms equipped with computers was calculated into percentages. As can be seen in TABLE L, silence occurred most frequently (37.5%); followed by gives information (21.4%); teacher initiated statements (17.8%); teacher response (7.6%); answers questions (5.4%); laughing, exclamation (3.2%); gives directions (2.0%); criticizes (0.9%); and praises and encourages (.5%). The high proportion of silence and small amount of praise coded is similar to the research findings of a study done in a pediatric setting (Klinzing, Klinzing & Schindler, 1977).

An examination of the communication interactions which occurred at the computers provided one very interesting finding (see TABLE M). In the 4-year-old class over three-fourths of all the praise was observed at the computer stations. This indicates that a very positive climate existed as the 4-year-old children interacted at the computer stations. This finding can probably be attributed

to the novelty of the computers since a similar finding did not occur with the 5-year-old children.

Sex Differences in Children's Use of Activity Stations

To determine whether the preschooler's use of the activity stations varied according to sex, t-tests (Mendenhall & Reinmuth, 1982) were performed. The t-tests were based on the ratio of the number of times a child was observed at a station and the total number of times a child was observed at all stations.

Two statistically significant sex differences were found with the 4-year-old children's use of activity stations. The 4-year-old males used the computer significantly more often than the 4-year-old females and the 4-year-old females used the free art station significantly more often than the 4-year-old males.

Two statistically significant sex differences were found with the 5-year-old children's use of activity stations. The 5-year-old males used the blocks significantly more often than the 5-year-old females and the 5-year-old females used the language arts station significantly more often than the 5-year old males.

The observers reported some interesting anecdotal information which pertains to the sex difference which

occurred with the 4-year-old children. At the beginning of the free play period the males often moved quickly to the computer stations leaving the females to choose other stations. Later when the computers were free, the females were often engaged in other activities, particularly housekeeping, and they did not usually abandon this activity to work on the computers.

Summary, Conclusions and Suggestions for Further Research

In this study systematic observations were made of the play behavior of 4 and 5-year-old children in two preschool classrooms which contained various activity stations including computer stations. Results of data analyses indicated that: (1) while the 4-year-old males used the computer extensively, the other children seemed to place the use of the machines in perspective; (2) the children in the preschool were active participants rather than passive observers; (3) the computers seemed to encourage both cooperative as well as independent play; (4) while the preschool activities were generally not teacher directed the teachers did tend to direct the computer activities of the 4-year-old children; (5) a comparatively large amount of praise occurred as the 4-year-old children played with the computers and that; (6) the 4-year-old males used the

computer significantly more often than the 4-year old females.

The limited nature of this study does not permit firm conclusions to be drawn from the results. Nevertheless, the results do show that introducing computers into preschool classrooms can provide children with additional beneficial activities and that early childhood professionals can "program a place for the microcomputer among the carefully selected activities we provide for children to explore" (Burg, 1984, p. 33).

While, the results of this study contribute to the growing body of evidence which supports the introduction of computers into preschool classrooms, much additional research is needed. It would be useful to replicate the present study in numerous and various preschools to see if the results of introducing computers into preschool classrooms continue to be positive. In addition, experimental studies should be conducted to test the effectiveness of various software programs designed for preschoolers. Also, longitudinal studies should follow preschoolers who used computers to see if their interest in computers is maintained and to identify possible long term influences.

The results of these studies and similar studies can further identify the benefits and risks of introducing

computers into preschool classrooms and thus help insure that decisions about computers and children are based on information and evidence rather than hope, fear, or speculation.

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TABLE A

PARTEN'S PLAY CLASSIFICATIONS

1. Unoccupied
2. Solitary
3. Onlooker
4. Parallel
5. Associative
6. Cooperative

TABLE B

FLANDER'S INTERACTION

ANALYSIS SCALE

1. Praises, encourages
2. Asks questions
3. Answers questions
4. Gives information
5. Gives directions
6. Criticizing, commanding, demanding or complaining
7. Laughing or exclamation
8. Teacher initiated statement
9. Teacher response
10. Silence

TABLE C

POPULARITY OF COMPUTER STATIONS COMPARED TO OTHER STATIONS

FOR 4-YEAR-OLDS

STATION	MALES			FEMALES		
	Total Rank	Computer Activity Total Rank	Paired Rank Difference (Absolute Value)	Total Rank	Computer Activity Total Rank	Paired Rank Difference (Absolute Value)
Housekeeping	14.5	17.5	3.0	9.0	37	28.0 *
Manipulatives	53.0	17.5	35.5 *	45.5	37	8.5
Art/Sensory, Cooking, Science	43.5	17.5	26.0 *	22.0	37	15.0
Water and Sand	50.0	17.5	32.5 *	47.0	37	10.0
Free Art	59.0	17.5	41.5 *	35.0	37	2.0
Cognitive Language Arts	53.0	17.5	35.5 *	30.0	37	7.0
Blocks	33.5	17.5	16.0	26.5	37	10.5

Critical Value for Friedman's Rank Sum (K) = 20.77 for males
= 23.55 for females

*p < .05

TABLE D

POPULARITY OF COMPUTER STATIONS COMPARED TO OTHER STATIONS

FOR 5-YEAR-OLDS

STATION	MALES			FEMALES		
	Total Rank	Computer Activity Total Rank	Paired Rank Difference (Absolute Value)	Total Rank	Computer Activity Total Rank	Paired Rank Difference (Absolute Value)
Free Art	26.5	24.0	2.5	31.5	30.0	1.5
Language Arts	32.0	24.0	8.0	22.5	30.0	7.5
Housekeeping	31.0	24.0	7.0	49.0	30.0	19.0
Blocks	23.5	24.0	.5	56.5	30.0	26.5 *
Manipulators	31.5	24.0	7.5	40.5	30.0	10.5
Art, Cooking, Science	31.5	24.0	7.5	21.0	30.0	9.0

Critical value for Friedman's Rank Sum (K) = 27.12 for males
= 23.92 for females

* $p < .05$

TABLE E

4-YEAR-OLD CHILDREN'S PLAY BEHAVIOR X

ACTIVITY STATION

STATION	Unoccupied	Solitary	Onlooker	Parallel	Associative	Cooperative	Total
Housekeeping	0	1	0	9	20	17	47
Computers	1	7	0	2	8	17	35
Manipulative	0	6	0	3	0	1	10
Art/Cooking/ Science	0	3	0	17	6	0	26
Water/Sand	0	2	0	4	5	2	13
Free Art	0	8	1	8	1	1	19
Cog. LA	0	4	1	12	2	0	19
Blocks	0	2	2	7	12	7	30
TOTAL	1	33	4	62	54	45	199

TABLE F

5-YEAR-OLD CHILDREN's PLAY BEHAVIOR X

ACTIVITY STATION

STATION	Unoccupied	Solitary	Onlooker	Parallel	Associative	Cooperative	Total
Free Art	1	7	0	20	2	5	35
Cog./LA	0	12	0	10	4	10	36
Housekeeping	0	0	0	3	8	5	16
Blocks	0	2	0	3	6	10	21
Computer	0	25	4	1	7	7	44
Math	0	12	0	12	10	2	36
Art/Cooking/ Science	0	5	0	22	7	6	40
TOTAL	1	63	4	71	44	45	228

TABLE G

RANKINGS OF PARTEN'S PLAY CLASSIFICATIONS

AND RESULTS OF FRIEDMAN'S RANK SUMS

	4-YEAR-OLDS		5-YEAR-OLDS	
Rank Differences (Absolute Values)	Males	Females	Males	Females
$[R_1 - R_2]$	14.5	10.5	14.5	15.0
$[R_1 - R_3]$	2.0	2.5	3.0	2.0
$[R_1 - R_4]$	33.0 *	26.0 *	27.0 *	38.0 *
$[R_1 - R_5]$	33.5 *	28.5 *	24.0 *	27.5 *
$[R_1 - R_6]$	31.0 *	19.5	23.5 *	28.5 *
$[R_2 - R_3]$	12.5	8.0	11.5	13.0
$[R_2 - R_4]$	18.5	15.5	12.5	23.0 *
$[R_2 - R_5]$	19.0	18.0	9.5	12.5
$[R_2 - R_6]$	16.5	9.0	9.0	13.5
$[R_3 - R_4]$	31.0 *	23.5 *	24.0 *	36.0 *
$[R_3 - R_5]$	31.5 *	26.0 *	21.0 *	25.5 *
$[R_3 - R_6]$	29.0 *	17.0	20.5 *	26.5 *
$[R_4 - R_5]$	.5	2.5	3.0	10.5
$[R_4 - R_6]$	2.0	6.5	3.5	9.5
$[R_5 - R_6]$	2.5	9.0	.5	1.0
	*$p < .043$ Critical Value = 23	*$p < .049$ Critical Value 20	*$p < .049$ Critical Value = 20	*$p < .043$ Critical Value = 23

R_1 = unoccupied play; R_2 = solitary play; R_3 = onlooker play;

R_4 = parallel play: R_5 = associative play; R_6 = cooperative play

TABLE H

CHILDREN'S PLAY BEHAVIOR AT ALL STATIONS

AND AT

COMPUTER STATIONS

	4-YEAR-OLDS			5-YEAR-OLDS		
Play Classification	Frequency for all Stations	Frequency at Computer Stations	Play at Computer/total Play	Frequency for all Stations	Frequency at Computer Stations	Play at Computer/total Play
Unoccupied	1(0.5%)	1	100.0%	1(0.4%)	0	0.0%
Solitary	33(16.6%)	7	21.2%	63(27.6%)	25	40.3%
Onlooker	4(2.0%)	0	0.0%	4(1.8%)	4	100.0%
Parallel	62(31.2%)	2	3.2%	71(31.1%)	1	1.4%
Associative	54(27.1%)	8	14.8%	44(19.3%)	7	15.9%
Cooperative	45(22.6%)	17	37.8%	45(19.8%)	7	15.6%
TOTAL	199(100%)	35	-----	288(100%)	44	-----

TEACHER DIRECTION

4-YEAR-OLDS

STATION	Station Teacher Directed	Station Not Teacher Directed
Housekeeping	0	56
Computers	22	42
Manipulators	4	14
Art/Cooking/Sci.	6	32
Water/Sand	1	19
Free Art	2	23
Cognitive	10	22
Blocks	6	36
TOTAL	51	244

TABLE J

TEACHER DIRECTION

5-YEAR-OLDS

STATION	Station Teacher Directed	Station Not Teacher Directed
Free Art	3	39
Language Arts	12	37
Housekeeping	2	19
Blocks	2	23
Computer	16	51
Manipulative	7	34
Art/Cooking/Sci.	2	45
TOTAL	44	248

TABLE K

TEACHER DIRECTION VS. NO TEACHER DIRECTION

AT THE COMPUTERS

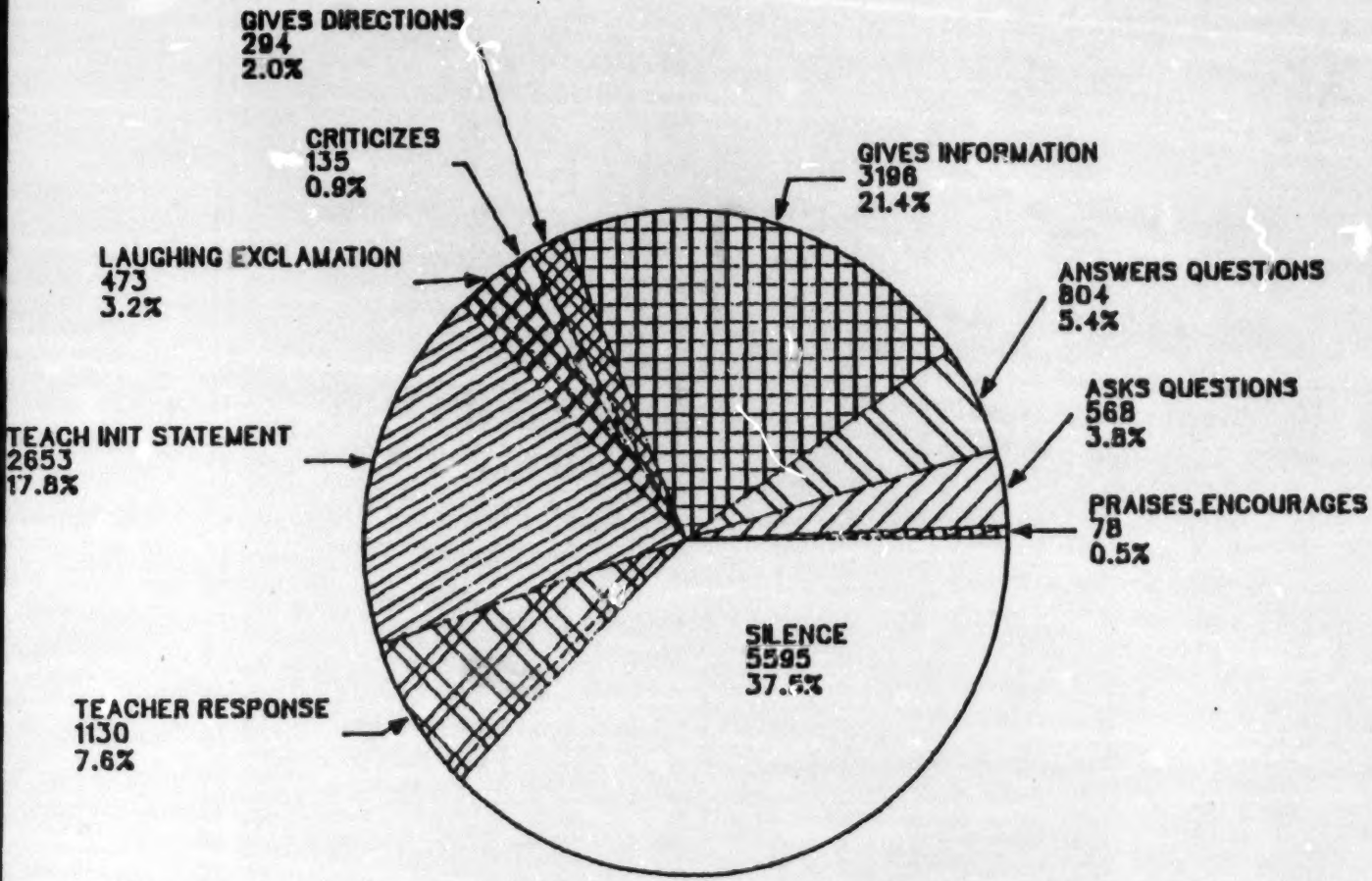
4-YEAR-OLDS		5-YEAR-OLDS	
Total Rank for Positive Differences (TD minus no TD)	Total Rank for Negative Differences (TD minus no TD)	Total Rank for Positive Differences (TD minus no TD)	Total Rank for Negative Differences (TD minus No TD)
67	11 *	57	21

Wilcoxon Signed Rank Critical Value = 17

*$p < .05$

TABLE L

COMMUNICATION INTERACTION FREQUENCIES



Sample size: 14926

TABLE M

COMMUNICATION INTERACTION AT THE COMPUTER

Category	4-YEAR-OLDS		5-YEAR-OLDS	
	N	Frequency at Computer/Total Frequency	N	Frequency at Computer/Total Frequency
Praises, Encourages	48	76.2%	2	13.3%
Asks Questions	50	18.1%	27	9.3%
Answers Questions	94	20.5%	56	16.4%
Gives Information	390	24.6%	217	13.8%
Gives Direction	45	33.3%	20	13.1%
Criticizes	12	15.2%	5	9.1%
Laughing, Exclamation	65	27.9%	15	6.3%
Teacher Initiated Statement	269	19.2%	255	22.4%
Teacher Response	64	12.6%	53	8.5%
Silence	700	27.7%	1003	32.7%
TOTAL	1737	---	1653	---

TABLE N

COMPUTER USE BY SEX

	4-YEAR-OLDS		5-YEAR-OLDS	
Child	MALE	FEMALE	MALE	FEMALE
1.	8/47 = 17.02	5/39 = 12.82	6/43 = 13.95	3/44 = 6.82
2.	11/50 = 22.00	2/30 = 6.67	4/39 = 10.26	13/42 = 30.95
3.	9/45 = 20.00	0 = 0.00	4/38 = 10.52	5/30 = 16.67
4.	12/42 = 28.57	9/41 = 21.95	7/39 = 17.95	6/36 = 16.67
5.	5/23 = 21.74	1/41 = 2.44	5/31 = 16.13	5/30 = 16.67
6.	20/42 = 47.62	0 = 0.00	6/38 = 15.79	3/39 = 7.69
7.	12/49 = 24.49	8/46 = 17.39	3/38 = 7.89	9/38 = 23.68
8.	10/46 = 21.74			3/23 = 13.04
9.	9/28 = 32.14			1/35 = 2.86
	$\bar{x}$ = 26.74	$\bar{x}$ = 6.94	$\bar{x}$ = 13.22	$\bar{x}$ = 15.00
	s = 9.83	s = 9.11	s = 3.71	s = 8.73
	t = 4.1243 *		t = .9968	
	$t_{.05}(14)$ = 1.761		$t_{.05}(14)$ = 1.761	

* $p < .05$